

IX. *Notes on the Cases of some South Brazilian Trichoptera.* By Dr. FRITZ MÜLLER.*

[Read May 7th, 1879.]

LITTLE is known about the cases of extra-European Trichoptera. A short account of those observed by me in Southern Brazil may therefore be of some interest.

Of the seven families into which Trichoptera are at present divided, only five have as yet been found here, viz., *Sericostomatidæ*, *Leptoceridæ*, *Hydropsychidæ*, *Rhyacophilidæ* and *Hydroptilidæ*. These may be grouped into two main divisions according as their pupæ are active or inactive. In the first group, comprising the *Sericostomatidæ*, *Leptoceridæ* and *Hydropsychidæ*, the case of the pupa is provided with small openings at either end, through which a continual current of water passes moving from the anterior to the posterior extremity. The pupa is in incessant activity to maintain this current; this is done, at least in most species, principally by the appendages at the end of the abdomen, which may be seen playing in the opening at the hind-end of the case. In the second group, containing the *Rhyacophilidæ* and *Hydroptilidæ*, the larva spins a cocoon closed all around, in which the pupa lies quite motionless. This cocoon is either free within the case (*Rhyacophilidæ*), or confluent with the walls of it (*Hydroptilidæ*). The fixity or mobility of the cases does not afford a distinctive character of the two last-named families; for there are not only Rhyacophilideous larvæ living in portable cases and Hydroptilideous larvæ living in fixed ones, but there are even cases fixed and movable at the same time, being fastened by a long flexible string (*Rhyacopsyche*).

* Figures and full descriptions of the cases mentioned in the following notes have been sent for publication to the "Archivos do Museu Nacional do Rio de Janeiro."

[Some additional notes appear in the Report of the Proceedings of the Meeting of the Entomological Society, held on the 2nd April, 1879; cf. Proceedings, pp. vi—viii.—ED.]

SERICOSTOMATIDÆ.

This family, as far as I know, is here represented only by the curious genus *Helicopsyche*, of which I have seen about half-a-dozen species. The case of one species is remarkable for the first built portion of it being straight. When preserved in adult specimens, this oldest portion peeps out from the top of the heliciform case like a little chimney. Most of the larvæ of *Helicopsyche* are rather sluggish animals, often resting motionless on the same spot for the whole day; they then retire into their cases after having fixed them temporarily with some threads of silk, a custom which is to be observed also in various Leptocerideous larvæ. In none of our species have I seen branchiæ, which, according to Brauer, exist in *Helicopsyche ceylanica*. Before passing into the pupa state, the larva shuts its case with a flexible corneous covering, provided in most of our species with a long, simple transverse slit; in one species the margins of the slit are serrated, and in another species there is no slit at all, but a sieve-like spot near the centre of the covering. As to the pupæ, Brauer says, that those of *H. ceylanica* have a pair of hook-bearing corneous patches at the basis of the abdominal segments from the second to the sixth, and there are also five pairs in his figure. This would be very strange, for the number and shape of these patches is generally very constant within the limits of the same genus, and in all our species of *Helicopsyche* there are four pairs only, situated at the basis of the third, fourth, fifth and sixth abdominal segments; each patch bears near its posterior end two or three short, rather blunt teeth, which are directed backwards. There is also, as usually, a pair of corneous patches at the end of the fifth abdominal segment, armed with strong, sharp, curved teeth, which are directed forwards.

One of our species of *Helicopsyche* lives on rocks wetted by the spray of waterfalls; it is by far more lively than the other species. The waterfalls, which are of very frequent occurrence in all our mountain rivulets, are generally frequented by three more species of Trichopterous larvæ, belonging to three different families (*Leptoceridæ*, *Hydropsychidæ* and *Hydroptilidæ*). Now the pupæ of those four widely-different species agree in their feet of the second pair of legs being deprived of the fringes of

long hairs, by the aid of which the pupæ of other Trichoptera swim to the surface of the water when they are about to undergo their final transformation.

In those species of *Helicopsyche*, which I have bred, the perfect insects used to emerge from the pupæ soon after sunset.

LEPTOCERIDÆ.

Of M'Lachlan's first section of this family I have not yet seen here any species.

SECTION II.

Two of our genera appear to belong to this section.

Genus I.

(Near *Odontocerum*, though distinguished by numerous differences. Antennæ not dentate; eyes of the ♂ very large, meeting on the vertex in one species and nearly so in another; radius of the anterior wings confluent at its apex with the first apical sector, &c.)

The case of the larva is a slightly-curved, cylindrical, firm tube, built with sand grains; the tail-end is closed with a transverse wall, having at its upper or dorsal margin a rather large oval or semicircular opening. Before its change the larva cuts a portion of the tail-end of its tube and then fixes the ventral side of either end and closes them by a single stone (in one species), or by a wall built of several fragments of stone (in a second species), in such a way that there remains at the ventral side of each extremity a narrow crescentic slit, the ventral margin of which is beset with a row of teeth. It is curious that the manner of closing the tail-end should be quite different in the larva and in the pupa cases. The pupa has five pairs of corneous patches at the basis of the abdominal segments (from third to seventh), each of the patches bearing a single blunt tooth, and there is the usual pair of patches at the end of the fifth segment, having two short sharp teeth.

The perfect insects emerge from the pupæ in the evening, generally later than *Helicopsyche*. On this occasion the fasciculate branchiæ of the pupa are shed, like those of *Ephemeridæ*, and this is the most remarkable feature of the genus; for it appears, that in most Trichoptera the

branchiæ of the pupa subsist in the imago in a rudimentary condition.

There are here two species of this genus, differing much in size, the larvæ of which live in clear rivulets; a third species of larvæ, building unusually short and wide tubes, of which I have seen but very few specimens in the River Itajahy, probably belongs to the same genus.

Genus II. GRUMICHA, of Saint Hilaire.

The wings having no median cell, the insect cannot be placed in M'Lachlan's fourth section, while, by the moderate length of the antennæ and the presence of the apical fork, No. 2, in all the wings it is excluded from Section III. Thus I place it here, though it shows no particular relation to *Odontocerum*. (Spurs 2, 2, 2. Discoidal cell closed, and radius connected to the first apical sector by a transverse nervule in all the wings. Apical forks, Nos. 1, 2, 3, 5 in the anterior, 1, 2, 5 in the posterior, wings.) The well-known black *Dentalium*-like tubes of the larvæ are frequent in some of the larger tributaries of the Itajahy. The larvæ are remarkable for the tibiæ of the hind legs consisting of two joints. The tail-end of the tube is closed with a transverse wall, having a central circular opening. Before its change the larva fixes the mouth-end of its tube by a petiolated disc to some stone or to other tubes of the same species. Clusters of more than a hundred specimens are sometimes found. The mouth-end of the tube is closed with a circular covering, provided with a transverse opening beneath its centre.

SECTION III.

Genus I. TETRACENTRON, Brauer.

One species of this New Zealand genus is extremely common here. The larva, which, like those of *Grumicha*, have two-jointed tibiæ on the hind legs, lives in sticks of wood, fragments of branches, of petioles of *Cecropia* leaves, &c. These are hollowed out in convenient lengths, and a semicircular piece is cut away from the ventral side of the mouth-end, so that the dorsal side projects, protecting the larva when crawling about; besides this, for more protection, a small stone is fastened to the projecting dorsal side, which closes the entrance when the larva retires into its case, and covers its head when feeding.

Near the end of the boring a small hole is gnawed through the wall of the stick for the issue of the respiratory current. For its transformation the larva fixes the ventral side of the mouth-end of its case to some stone or tree (preferring the latter, when obtainable), and closes the entrance with a stone; the interior of the stick is clothed with a silken tissue, forming a cylindrical cocoon, closed with a sieve at either end; the centre of the anterior sieve is attached to the stone, which serves as a covering. It often happens that the larvæ find hollow sticks; but even then they gnaw, before their change, a quite purposeless hole through the wall of the stick. (See Kosmos, "Gratulationsheft zum 70 jährigen Geburtstage, Ch. Darwins," p. 395, fig. 6.) The pupæ agree in the number and arrangement of the corneous patches of the abdomen with those of *Helicopsyche*, but each patch is armed with from four to six sharp hooks. The branchiæ of the pupa are not shed in the final transformation; they can easily be seen in the imago when it is put into spirits of wine immediately after issuing from the pupa.

Sometimes tubes of *Grumicha* are met with, which, instead of a corneous covering, are shut with a stone (such were, e. g., the tubes described by Hagen in Stettin. entom. Zeit. 1864, p. 226), and these, on examination, are found to contain pupæ, not of the maker of the tube, but of an intruding *Tetracentron*. I do not know whether it is a distinct species.

In some small mountain rivulets I have found tubes of various smaller *Leptoceridæ* (*Setodes* (?), *Grumichella*, &c.) tenanted by intruders, which have the curious habit of fastening to the mouth-end of the tube bits of wood or sticks, sometimes much longer than the tube, and concealing it almost completely. I have not yet seen the imago, but the larvæ agree (e. g., in the two-jointed tibiae of the hind legs) with those inhabiting hollow sticks.

Genus II. GRUMICHELLA, nov. gen.

(Very nearly related to *Leptocerus*. The neururation of the anterior wings is quite the same; in the posterior wings apical fork No. 1 is wanting, while Nos. 3 and 5 are present in both sexes. Proportion of the joints of the maxillary palpi 10, 15, 20, 9, 17.)

The larvæ inhabit waterfalls and rapids of mountain rivulets. But for size their tubes closely resemble those

of *Grumicha*, which are thrice as long. It is rather curious that those almost identical tubes should belong to species quite different in their larval, pupal and imago states.

The tubes of *Grumichella* show two interesting contrivances, by which they are adapted to their peculiar habitat—1, from the wall which closes the tail-end of the tube, and which has, as in *Grumicha*, a central circular opening, there projects, on the ventral side of the opening, a short, stout, triangular tooth or spur, which, being inserted into minute crevices of the rocks, probably serves to give hold to the tubes; 2, the little petiole or foot-stalk of the disc, by which the pupa case is fastened, does not proceed, as in *Grumicha*, from the margin of the tube, but from the corneous covering. The pupa cases being usually fastened with the mouth-end turned upwards to perpendicular rocks, along which a thin sheet of water is pouring down, if the tubes were fastened, the pupæ, after having loosened the covering, would hardly be able to creep out of their tubes, and, if they succeeded in doing so, the tender, fragile creatures would almost infallibly be crushed. But now, after loosening the covering which remains fastened to the rock, they are within their tubes safely carried away by the water to some quiet place, where they may with leisure creep out and undergo their final transformation. The pupa is remarkable for its last abdominal segment being unusually long (as long as the three preceding ones), and tapering towards the end. Number of dorsal patches as in *Helicopsyche*, each patch armed with two short, sharp teeth.

Genus III. SETODES (?).

There are here three species agreeing in general appearance and in the neuration of the anterior wings (one of them even in colouring) with *Setodes punctata* and *viridis*; but the posterior wings are broader.

The larvæ, the antennæ of which are longer than in any other Leptocerideous larva known to me, live in narrow, cylindrical, straight or slightly-arcuated leathery tubes. Before its change the larva considerably shortens its tube, the ventral side of either end of which is then fixed by means of a disc, usually bilobed, and the extremities closed with coverings having a central circular or elliptic opening. The appendages at the end of the

abdomen of the pupa are very long; the number of the dorsal patches is as in *Grumichella*, &c., those at the basis of the 4th, 5th and 6th segments have two or three teeth, but those at the basis of the third and at the end of the fifth segments have two pairs of teeth, those of one pair being much smaller.

In one of the three species the slightly-arcuated brown tubes are covered with very fine sand; the larvæ of this species swim very well, their hind legs being furnished with long fringes. The imago is the most beautiful Trichopterous insect I have ever seen.

In the second species the straight tubes are covered with narrow bits of wood or other vegetable fibres; those on the back are arranged longitudinally, projecting considerably beyond the mouth-end of the tube; those on the sides and beneath are disposed in an oblique direction.

In the third species to either side of the back of the straight tube there are fixed a row of bits of wood, projecting laterally, and generally decreasing towards the tail-end.

Genus IV.

From the great length of its hind legs I suppose that a little larva, which makes curious nearly cylindrical cases with the seeds of *Callitriche*, must be placed in this section.

SECTION IV.

The cases of the three species of this section, with the larvæ of which I am acquainted, differ from those of all other *Leptoceridæ* by their inner silken tube being much flattened, the height being equal, or nearly so, to half the breadth. The external aspect of the cases is yet much more flattened and broad; for they are covered with bits of leaves, which laterally project more or less beyond the inner tube.

In the largest species the cases of adult larvæ are usually made of four leaves (sometimes there are but three), two forming the ventral and two the dorsal side; the anterior dorsal leaf is produced far over the ventral one, so as to protect the larva when moving about. This species lives in rivulets. The case of the pupa is fixed at the mouth-end, either extremity of the interior tube being closed with a sieve.

In the smallest species, which lives on trees between

the leaves of *Bromeliæ*, there are generally five or six bits of leaves on the ventral, and one more (six or seven) on the dorsal side of the tube. Before its change the larva closes the mouth end by fastening one more bit of leaf to the ventral side.

This is also done by the third species, intermediate between the other two in size as well as in the number of leaves used in the construction of its case; there are generally three or four on the ventral and four or five on the dorsal side. This species lives principally in very small rivulets; with hardly any water, trickling along a declivitous rocky ground.

To the different habitat of these three species corresponds a remarkable difference in the feet of the pupæ. In the first species there are not only dense fringes of long hairs on the second pair, but similar hairs, though much less developed, exist also on the feet of the fore-legs. These fringes are rather rudimentary in the third species, and completely wanting in the *Bromelia* species, which in this respect agrees with the waterfall Trichoptera.

The pupæ have more dorsal patches than any other of our *Leptoceridæ*; for there is a pair on the eighth abdominal segment also, and besides this, there is on the back of the ninth segment a pair of long spear-shaped horny processes.

The first species emerges from the pupa in the evening, as most *Leptoceridæ* do, but the *Bromelia* species usually during the first hours of the afternoon (at least in captivity). The branchiæ of the pupa subsist, in a rudimentary condition, in the perfect insect.

The three species agree, not only in the construction of their cases, in the structure of their larvæ and pupæ, but also in the neuration of the wings and other characters of the perfect insects (in all the wings the radius is confluent at its apex with the first apical sector; in the posterior wings the discoidal cell is open, the apical forks Nos. 2, 3 and 5 being present). It would be most unnatural to separate them into two genera, and yet they differ in the number of spurs. In the *Bromelia* species there are 2, 4, 2 in both sexes, while the other two have 2, 4, 4. In any other respect the intermediate species resembles more closely to the *Bromelia* species than to the larger one, with which it agrees in the number of spurs.

HYDROPSYCHIDÆ.

Genus I. MACRONEMA.

The larva of one species is extremely common, being met with almost everywhere under large stones. The larva makes a very rude dwelling with irregularly-accumulated and loosely-connected stones. The case of the pupa is by far more solid and regular, at least when viewed from within. The inner room is oval, the surface smooth, and the stones of the wall firmly connected. At either end a few small openings may be detected, leading through the wall. Within the case there is a cylindrical silken cocoon, which is loosely connected with, but may be easily separated from, the walls of the stone-case, and which has a transverse sieve at either end.

Genus II. TINODES (?).

Cases similar in general appearance to those of *Tinodes maculicornis* are very common on rocks exposed to the spray of waterfalls. They consist of a soft silken ribbon interwoven and covered with microscopical algæ, diatoms and mud, and curved into a semicylinder. These canals without a basal wall can hardly be called "tubes." The larva is remarkable for its very long spinneret, which projects beyond the head. I have not yet seen the imago.

Genus III.

I do not know the imago; in the pupa I found 2, 4, 4 spurs. The cases, of which I have seen but very few specimens in the River Itajahy, are interesting on account of their close resemblance to those of the Hydroptilideous genus *Peltopsyche*; indeed, before I had an opportunity of examining the larvæ and pupæ I supposed them to be some new species of *Peltopsyche*, or even unusually large specimens of *Peltopsyche Maclachlani*. They are flat, elliptical, smooth, buff-coloured shields, with a small opening at either end, fixed to the upper side of stones,

Genus IV. RHYACOPHYLAX, nov. gen.

(Appears to be nearly related to *Smicridea*, but the number of spurs is different, being 1, 4, 4 in the ♀, and 1, 4, 2 in the ♂.)

This is, no doubt, as to the cases, the most curious of all our *Hydropsychidæ*. The cases themselves are rather rude canals, covered with irregularly-interwoven vegetable fibres, but at its mouth-end each case has a large funnel-shaped verandah, covered with a very beautiful silken net. The larvæ live in the rapids of various rivulets, and the entrance of the verandah is invariably directed towards the upper part of the rivulet, so as to intercept any eatable things brought down by the water. Generally, a more or less considerable number of larvæ build their cases close together, so as to form transverse rows, on the upper side, of stones. Lately, I saw, on a large stone, about half-a-dozen parallel rows, at some distance from one another; one of them, being about 0.2 m. long, must have been composed of about thirty cases. Before the end of the larval period the vegetable fibres are replaced by small stones, and the verandah is destroyed, either by the larva or by the current of the water. One day, when I was taking to my house a stone with beautiful *Rhyacophylax* cases, some of the larvæ left their houses, crept to the edge of the stone and then descended, suspending themselves in the air, like spiders, by a thread of silk. The larvæ of *Grumichella*, also, may be seen suspending themselves in the water in a similar way. Such a faculty must prove highly serviceable to larvæ living in rapids, where they might otherwise be easily swept away by the current.

RHYACOPHILIDÆ.

Genus I.

(Spurs of a ♂ pupa 2, 4, 4.)

The larva lives, principally, without any case, between the entangled stems of various *Podostemeæ*, which densely cover the stones in the rapids of the Itajahy and its tributaries. It is carnivorous, fragments of insect larvæ (*Hydropsychidæ*, *Perlidæ*, &c.) being found in its intestines, and its anterior legs are armed with very

powerful and curious forceps; the femur is very thick, and has on its distal inferior angle a stout process, resembling the thumb on the hand of a crab; the tibia and tarsus are extremely short, so that the curved claw impinges against the process of the femur. The cocoon of the pupa, also, is not protected by a regular case; sometimes there are some loosely-connected stones around it, but at other times it appears to lie, without any special protection, between the *Podostemeæ*. The feet of the first and second pair of legs are provided in the pupa with strong well-developed claws, which I have not yet seen in any other Trichopterous pupa. They are, probably, very useful to the pupa of this species, which has to make its way between the densely-intricate stems of *Podostemeæ*.

Genus II.

The larvæ of some smaller species of *Rhyacophilidæ* build portable cases, agreeing with those of most *Hydroptilidæ* in not showing any difference between the two extremities. They are built of stones, oval, with a flat bottom, on either end of which there is an opening; the stones generally being of comparatively large size, the external aspect is often very irregular. As the two doors of these little stone-houses are in the flat bottom, they would not freely admit the water necessary for respiration, when the larva is at rest, and there are special contrivances for the access of water varying in the several species. In one species, frequenting small mountain rivulets, small passages are left between the stones of the dorsal side of the house. In another species, which often covers by countless thousands the stones in clear streams, an upright cylindrical chimney, made of grains of sand, rises from the middle of the house; its height sometimes equals, or even exceeds, the length of the house. When the larva is about to change, the bottom and chimney are removed, the borders of the vault are fixed to the stone, on which it lives, and then a cocoon of the usual form is spun.

HYDROPTILIDÆ.

In Hagen's list of South American Neuroptera (Synopsis of the Neuroptera of North America, 1861, p. 299), no species of this family is mentioned, and yet it will probably

prove to be one of the most numerous Trichopterous families in this country, including the most varied and remarkable larval cases.

Genus I.

There are here various species, the cases of which resemble more or less closely the well-known cases of *Phrixocoma pulchricornis*, being much compressed from the sides and opened by a narrow slit at each end. They are either naked, or covered with very fine sand, or with algæ or diatoms, which in one species are arranged in an extremely elegant manner. The cases of the pupæ are fixed either along the whole ventral margin or at the two ends, or in one species, abounding on the rocks of waterfalls, at one end only.

Genus II.

Very minute, nearly cylindrical, coriaceous, brown tubes; covered with very fine sand, which in the pupa state are fixed at either end to the underside of stones, showing generally two adhesive discs on the anterior, and a single one on the posterior end. They are common almost everywhere.

Genus III. DIAULUS LADISLAVII.

Strongly-compressed oval cases, elegantly covered with diatoms, with a narrow slit at each end, and having on the dorsal margin two (or, as I have seen in one specimen, three) cylindrical chimneys. The observation of living larvæ of this and of the first genus leaves no doubt as to the use of the chimneys. Those inhabiting cases opened only by a slit at each end are seen moving incessantly, and working very hard, in order to maintain a current of water through these narrow passages; those of *Diaulus*, on the contrary, may remain motionless for a very long time, the water necessary for respiration having a free access through the chimneys. The cases of the pupæ are fixed in an upright position along the whole ventral margin on the upper side of stones, and often these little houses form large villages of a rather picturesque aspect.

Genus IV. LAGENOPSYCHE.

An approximative idea of the cases may be formed by imagining the bottom of a bottle to be cut away and then

its under part to be compressed until the opposite sides touch each other, thus transforming the wide circular opening into a narrow slit. The mouth of the bottle represents the mouth-end of the larval case, and the long narrow slit at the tail-end is held in an upright position. In one species (*L. hyalina*) the case is quite colourless and perfectly hyaline; in a second species (*L. Spirogyræ*) it has a dark violet, or brownish, or blackish, colour, darker towards the mouth-end. For transformation the case is placed on one of its broad sides, and then fixed on either side of each end by means of petiolated discs; at the mouth-end of the larval case there are two discs in both the species, and as many exist at the opposite end in *L. Spirogyræ*, but in *L. hyalina* there are four, the petioles dividing before they expand into discs. After having fixed its case the larva turns its head towards the broader end of it, so that the mouth-end of the larval case becomes the tail-end of the pupa case, and *vice versâ*. *L. hyalina* lives in small rivulets under stones, *L. Spirogyræ* in slowly-moving or even standing waters filled with *Spirogyra*, *Callitriche* and *Heteranthera reniformis*; the larvæ are to be met with among the *Spirogyræ*, on which they seem to feed; the pupæ are fixed to the under side of the leaves of *Callitriche* or *Heteranthera*. The perfect insects emerge early in the afternoon.

Genus V. RHYACOPSYCHE HAGENII.

The larvæ live in rapids of mountain rivulets. The brown coriaceous cases of younger larvæ are nearly cylindrical and widely open at each end, afterwards they are widened in the middle, corresponding to the increasing thickness of the abdomen of the larvæ; from one end there proceeds a string of silken threads, generally about as long, but sometimes even more than twice as long as the cases, by which the latter are fastened to the upper side of stones. Thus the larva is secured against being carried away by the current, and at the same time by the mobility of its case its pasture ground is greatly enlarged, and the more so as it can issue indifferently at either end of its tube. It feeds on microscopical alga. Before its change the string is much shortened and thickened, being thus transformed into a rigid footstalk, able to sustain the case

in an upright position. The case of the pupa is somewhat compressed, oval or club-shaped, rounded at the upper, attenuated at the lower, end. The pupa emerges, for its final transformation, at the upper end of the case.

Genus VI. PELTOPSYCHE.

The larvæ live in larger tributaries of the Itajahy, preferring rapids. One species (*P. Maclachlani*) has as yet been found only in one single rapid near the mouth of the Warnow. The cases resemble in shape, colour and size the well-known egg-cases of *Nephelis*, and are fixed, often in very large numbers, to the upper side of stones; they are made of a brown, rather tough, coriaceous substance. Their upper wall forms a rather flat elliptical shield, smooth in *P. Maclachlani*, transversely striated in *P. Sieboldii*; the basal wall is very thin, and firmly glued to the underlying stone, so that it can hardly be separated without being torn. At either end of the case there is a small circular opening. In most *Hydroptilidæ* the abdomen of the older larvæ is much swollen; in *Peltopsyche* it is so in a quite extraordinary degree, filling nearly the whole case. The very slender anterior part of the body is bent and hidden beneath the huge abdomen, of which it appears to be only an insignificant appendage. The pupæ are remarkable for the unusually great difference which the complicated corneous patches on the back of the abdomen show in the two species. The perfect insects differ from all known Trichoptera by the antennæ of the ♂, some of the basal joints of which are produced into long processes exhibiting a complicated structure, very different in the two species, and which I have not yet been able to unravel in a satisfactory manner. From what I have seen, I am led to suppose that these strangely modified basal joints of the antennæ may be odoriferous organs.